Technical Library
Fort Detrick
Frederick, Maryland

PROCEEDINGS

OF THE

PHYSICAL SOCIETY

JULY TO DECEMBER 1960

VOLUME 76

Published by
THE INSTITUTE OF PHYSICS AND THE PHYSICAL SOCIETY
1 Lowther Gardens, Prince Consort Road,
London S.W.7

OFFICERS AND MEMBERS OF THE FIRST COUNCIL

PRESIDENT

Sir JOHN COCKCROFT, O.M., K.C.B., C.B.E., M.A., D.Sc., F.Inst.P., F.R.S.

IMMEDIATE PAST PRESIDENTS OF THE INSTITUTE AND OF THE SOCIETY

Sir GEORGE THOMSON, M.A., LL.D., Sc.D., Hon.F.Inst.P., F.R.S.
J. A. RATCLIFFE, C.B.E., M.A., F.R.S.

VICE-PRESIDENTS

Prof. R. W. DITCHBURN, B.Sc., M.A., Ph.D., F.Inst.P.
A. J. PHILPOT, C.B.E., B.Sc., M.A., F.Inst.P.
W. H. TAYLOR, M.A., D.Sc., F.Inst.P.
J. TOPPING, M.Sc., Ph.D., F.Inst.P.

HONORARY TREASURER

J. TAYLOR, M.B.E., D.Sc., F.R.I.C., F.Inst.P.

HONORARY SECRETARY

C. G. WYNNE, B.A., Ph.D., F.Inst.P.

ORDINARY MEMBERS OF THE COUNCIL

Prof. B. BLEANEY, M.A., D.Phil., F.R.S.
E. R. DAVIES, O.B.E., B.Sc., F.Inst.P.
Prof. B. H. FLOWERS, M.A., D.Sc.
J. M. A. LENIHAN, M.Sc. Ph.D. A.M.I.E.E., F.Inst.P.
G. R. NOAKES, M.A., F.Inst.P.
Prof. C. F. POWELL, M.A., Sc.D., F.R.S.
F. A. VICK, O.B.E., Ph.D., A.M.I.E.E., F.Inst.P.
Prof. D. A. WRIGHT, D.Sc., F.R.A.S., F.Inst.P.

REPRESENTING BRANCHES

M. R. HOPKINS, M.Sc., Ph.D., F.Inst.P.
Prof. H. LIPSON, M.A., D.Sc., F.Inst.P., F.R.S.

EXECUTIVE OFFICERS

Secretary:

H. R. LANG, B.Sc., Ph.D., A.R.C.S., F.Inst.P.

Deputy Secretary:

N. CLARKE, B.Sc., F.Inst.P.

Editor and Deputy Secretary:

A. C. STICKLAND, M.Sc., Ph.D.

CONTENTS

Part 1 — *July* 1960

PAGE

Dr. H. R. Allan, Dr. R. F. Beamish, Dr. D. A. Bryant, Dr. H. Kasha and Mr. R. D. Wills. An investigation of extensive air showers, using Cerenkov detectors 1

Dr. A. S. Kaufman, Mr. T. P. Hughes and Mr. R. V. Williams. SCEPTRE III —An intense source of the spectra of highly ionized atoms. 17

The late Prof. E. G. Richardson. The transmission of sound through a wake . 25

Prof. L. M. Garrido. Perturbations in classical mechanics 33

Dr. D. W. Swan. Interpretation of ion mobility measurements in argon and helium liquids 36

Dr. A. Dalgarno and Dr. A. L. Stewart. The Lamb shift of helium . . 49

Mr. B. E. F. Macefield and Dr. J. H. Towle. Energy levels of ^{29}P, ^{33}Cl and ^{41}Sc from (d, n) reactions. 56

Mr. J. M. Reid and Dr. B. Lalovic. The high energy photodisintegration of helium, nitrogen and neon 65

Dr. R. W. Morriss. Observations of sudden ionospheric disturbances . . 79

Mr. A. Branwood and Dr. R. H. Tredgold. The electrical conductivity of barium titanate single crystals 93

Mr. W. B. Nash and Dr. K. J. Standley. The wall effect in ferrimagnetic resonance experiments 99

Mr. E. Thornton. Viscosity and thermal conductivity of binary gas mixtures: xenon–krypton, xenon–argon, xenon–neon and xenon–helium . . . 104

Dr. P. A. Walker. The thermal conductivity and thermoelectric power of bismuth telluride at low temperatures 113

Dr. E. W. Billington. Some measurements of the elastic and viscous properties of thixotropic fluids 127

Mr. P. H. G. Dickinson and Prof. J. Sayers. Ion charge exchange reactions in oxygen afterglows 137

Dr. G. W. Greenlees and Dr. J. Lowe. The elastic and inelastic scattering of 19·6 MeV deuterons by Mg 149

Research Notes:

Mr. J. E. A. Lys and Mr. W. A. Runciman. The luminescence of uranium-activated fluorides 158

Dr. D. J. Craik and Dr. E. D. Isaac. Magnetic interaction domains . . 160

Letters to the Editor:

Dr. D. T. J. Hurle and Mr. S. Weintroub. The electrical resistivity of mono-crystalline and liquid bismuth 163

Dr. A. J. F. Boyle, Dr. D. St. P. Bunbury, Mr. C. Edwards and Dr. H. E. Hall. A thermal red shift of the recoilless γ-emission of ^{119}Sn^{m} . . 165

Corrigendum: Mr. R. V. Williams and Dr. S. Kaufman 168

Reviews of Books 168

Part 2 — *August* 1960

Mr. I. G. Austin. Infra-red Faraday rotation and free carrier absorption in Bi_2Te_3 169

Dr. R. Heastie and Mr. C. Lefebvre. Phase equilibria in condensed mixtures of argon and xenon 180

Dr. M. el-Nadi and Mr. M. Wafik. The direct inelastic scattering of deuterons . 185

25350

Part 2 (*cont.*) *August* 1960

PAGE

Dr. I. C. Percival. A variational principle for scattering phases 206

Dr. E. M. Reeves, Prof. R. W. Nicholls and Dr. D. A. Bromley. Optical excitation of N_2 by 0·5 to 1·5 Mev hydrogenic ions 217

Mr. A. N. Prasad and Prof. J. D. Craggs. Measurement of ionization and attachment coefficients in humid air in uniform fields and the mechanism of breakdown 223

Mr. D. E. Weston. Underwater explosions as acoustic sources 233

Mr. M. G. Haines. The Joule heating of a stable pinched plasma 250

Mr. J. F. Barnes and Dr. R. H. Tredgold. Field dependent electron mobility in ionic crystals 261

Mr. J. Sobhanadri. Calculations on ionic character and hybridization from dipole moments for AsF_3 and $AsCl_3$ 267

Dr. J. C. Anderson. Internal ferromagnetic resonance and magnetostatic modes in nickel–iron alloys 273

Mr. N. H. Saunders and Dr. R. S. Tebble. Magnetothermal effects in silicon–iron alloys 282

Research Notes:

Mr. S. K. Joshi and Dr. S. S. Mitra. Debye characteristic temperature of solids 295

Dr. K. W. Ogilvie. The half-value period of radium C′ 299

Mr. C. P. Flynn and Dr. E. F. W. Seymour. Knight shift of the nuclear magnetic resonance in liquid indium 301

Dr. P. H. E. Meijer. Note on the behaviour of a vapour–liquid system above and below the critical point 303

Letters to the Editor:

Prof. W. Low. Paramagnetic resonance spectrum of dysprosium in the cubic field of calcium fluoride 307

Dr. R. F. Pearson and Dr. R. W. Teale. Magnetic resonance and magneto-crystalline anisotropy in ytterbium iron garnet 308

Reviews of Books 311

Part 3 *September* 1960

Mr. R. A. Padmanabhan and Dr. E. L. Heasell. Ultrasonic relaxation in triethylamine 321

Dr. I. C. Percival. Waves in a conducting sheet situated in a strong magnetic field 329

Dr. P. K. Carroll and Dr. H. E. Rubalcava. Rotational analysis of the 5–1 band of the B′–B system of N_2 337

Dr. B. Dejon and Dr. K. Smith. Shadow effect in the scattering of Gev pions and nucleons by deuterons 346

Mr. B. R. Joshi and Dr. G. M. Lewis. On the measurement of orbital electron capture with particular reference to ^{131}Cs 349

Dr. D. M. Finlayson, Dr. I. S. Robertson, Dr. T. Smith and Dr. R. W. H. Stevenson. The optical absorption in manganese–zinc fluoride single crystals near the Néel temperature 355

Mr. M. S. Bhalla and Prof. J. D. Craggs. Measurement of ionization and attachment coefficients in carbon dioxide in uniform fields 369

Dr. J. M. Cowley and Mr. A. F. Moodie. Fourier images IV: the phase grating 378

Dr. P. D. Southgate. Internal friction in germanium and silicon I: electron and impurity relaxation 385

PAGE

Dr. P. D. SOUTHGATE. Internal friction in germanium and silicon II: oxygen movement and dislocation damping 398

Research Notes:

Dr. A. R. JOHNSTON and Prof. K. G. EMELEUS. Note on a pinch effect in a low-pressure arc 409

Dr. E. W. LEE and Dr. R. R. BIRSS. The magnetostriction of lithium–chromium ferrite in the neighbourhood of its compensation point 411

Dr. G. S. VERMA. Second dislocation relaxation peak in aluminium at low temperatures 412

Dr. C. HILSUM. Polar scattering in III–V compounds 414

Mr. S. B. KARMOHAPATRO. Charge exchange between argon ions and atoms . 416

Prof. A. G. MCLELLAN. Selection rules for spin–orbit matrix elements for the configuration f^n 419

Dr. A. DALGARNO. The stopping powers of atoms 422

Prof. E. WOLF. Correlation between photons in partially polarized light beams 424

Dr. J. G. RUTHERGLEN. Asymmetry in scattering of 90–140 MEV polarized protons from nuclear emulsion material 427

Dr. J. G. RUTHERGLEN and Mr. J. K. WALKER. The photoproduction of charged pions from deuterium 430

Dr. H. S. PERLMAN. Relativistic K shell stopping power theory 433

Letters to the Editor:

Dr. GY. GERGELY. On the Ehrenberg–Franks experiment relating to the penetration of electrons into luminescent material 437

Mr. D. I. PORAT and Mr. K. RAMAVATARAM. A proposed method for measuring ranges of heavy ions in solids 438

Dr. M. S. SODHA. Estimation of inelastic collision cross section from electron mobility measurements 439

Reviews of Books 442

Part 4 *October* 1960

Dr. P. J. ECCLES. Singly scattered delayed electrons in extensive cosmic ray air showers 449

Dr. S. SIMONS. Resistance anisotropy at low temperatures 458

Mr. A. C. PRIOR. A reversed carrier transport effect in germanium 465

Dr. C. B. WILSON. A phenomenological theory of the characteristic energy losses of fast electrons in metals 481

Dr. H. C. NEWNS. On the stripping of two nucleons 489

Miss C. RHYS-ROBERTS and Dr. R. H. TREDGOLD. A note on the theory of space charge limited currents 497

Dr. R. R. BIRSS and Dr. E. W. LEE. The saturation magnetostriction constants of nickel within the temperature range −196° to 365°C 502

Dr. I. H. KHAN. On the polymorphism of the thallium halides. 507

Mr. P. V. K. PORGESS and Dr. H. WILMAN. Surface re-orientation, friction and wear, in the unidirectional abrasion of graphite 513

Mr. C. P. FLYNN and Dr. E. F. W. SEYMOUR. Nuclear quadrupole coupling with conduction electrons in cubic alloys 526

Mr. T. L. JOHN. The numerical solution of the exchange equations for slow electron collisions with hydrogen atoms 532

Part 4 (*cont.*) *October* 1960

PAGE

Mr. D. W. L. Sprung and Dr. J. B. Willis. The spin–orbit potential in proton–proton scattering 539

Dr. S. Hinds and Dr. R. Middleton. A study of the ^{27}Al(^{3}He, d)^{28}Si reaction . 545

Dr. S. Hinds and Dr. R. Middleton. The energy levels of ^{24}Mg and ^{28}Si . . 553

Dr. K. Smith, Dr. W. F. Miller and Mr. A. J. P. Mumford. The elastic and inelastic scattering of electrons and positrons from the s-states of atomic hydrogen 559

Research Notes:

Dr. T. S. Moss and Mr. T. D. H. Hawkins. Interband photoconductivity in germanium 565

Mr. R. Carey. Measurements of optimum domain widths in silicon–iron . 567

Mr. R. Beer and Dr. L. Bovey. The hyperfine structure of some uranium and americium lines in the 1·6–2·1 micron region 569

Dr. B. Donovan. Note on the treatment of impurity scattering in optical absorption in semiconductors 574

Dr. C. J. Batty. Total and absorption cross section for high energy pions . 577

Letters to the Editor:

Prof. E. A. Guggenheim. The equilibrium distribution of N atoms on N sites (or in N cells) 580

Reviews of Books 582

Part 5 *November* 1960

Mr. C. J. Powell. The origin of the characteristic electron energy losses in ten elements 593

Mr. B. A. Robson and Mr. D. Robson. Spin–orbit effects in the inelastic scattering of 12 Mev neutrons in carbon 611

Dr. H. S. Perlman. The relativistic theory of K ionization by electrons . . . 623

Dr. W. N. Asaad. Relativistic K electron wave functions by the variational principle 641

Mr. N. R. Ranganathan and Dr. R. Vasudevan. The stochastic problem of electron–photon cascades including polarization 650

Mr. S. K. Majumdar. Electrodynamics of a charged particle moving through a plasma without magnetic field 657

Dr. P. J. Dean, Dr. P. J. Kennedy and Dr. J. E. Ralph. Particle excited luminescence in diamond 670

Dr. J. E. Ralph. Radiation induced changes in the cathodoluminescence spectra of natural diamonds 688

Mr. J. H. Pace, Mr. D. F. Sampson and Dr. J. S. Thorp. Spin–lattice relaxation times in ruby at 34·6 Gc/s 697

Dr. O. Klemperer and Dr. A. Thetford (with a note by Dr. F. Lenz). Transmission of slow electrons through thin films 705

Dr. C. J. L. Booker and Dr. J. L. Wood. Further electrical effects of the adsorption of water vapour by anodized aluminium 721

Dr. B. F. Figgins. The specific heats of solid argon and an equimolar argon–krypton mixture 732

Dr. I. S. Grant. Radiative transitions in ^{8}Be 737

Dr. C. F. Barnaby and Dr. J. C. Barton. Performance of large area scintillation counters 745

Part 5 (*cont.*) *November* 1960

PAGE

Prof. L. F. Bates and Mr. R. Carey. Domain patterns on 'cube-textured' silicon–iron sheet 754

Dr. B. S. Sood. Multipolarity and character of 961 kev resonance and 840 kev fluorescence radiation in ^{152}Sm 759

Dr. R. M. Glaister and Dr. H. F. Kay. An investigation of the cubic–hexagonal transition in barium titanate 763

Research Notes :

Mr. H. J. Wintle. The effect of attenuation on the acoustic resonant frequencies of gases in tubes 772

Dr. G. S. Verma and Mr. S. K. Joshi. Nuclear resonance absorption of ultrasound in KI and KBr 776

Dr. B. Dayal and Mr. S. P. Singh. Correct enumeration of vibration frequencies in the Brillouin zone 777

Dr. A. E. D. Heylen. Calculated electron mobility in hydrogen 779

Dr. H. K. Henisch and Dr. B. R. Marathe. A note on electroluminescence due to carrier accumulation 782

Dr. R. H. Jones. Hall coefficient and electrical conductivity measurements on lead selenide single crystals grown from the vapour 783

Dr. R. J. Elliott. Speculation on the centres formed by nitrogen in diamond 787

Dr. C. Curry and Mr. D. J. McNeill. Soft x-ray emission spectra of some transition and noble metals 791

Dr. Y. P. Varshni and Mr. R. C. Shukla. On Pauling's theory of alkali halide molecules 794

Dr. E. Fatuzzo. Switching properties of tetramethylammonium-trichloromercurate 797

Letters to the Editor :

Mr. N. K. Nayyar and Mr. G. S. Murty. The stability of an infinitive gravitating cylinder of paramagnetic material in the presence of magnetic field . 800

Dr. E. H. Putley. Impurity photoconductivity in n-type InSb . . . 802

Dr. S. Doniach. Catalytic magnetization of atomic hydrogen? . . . 806

Corrigendum:

Mr. N. Anderson. Compression waves in a plasma in a magnetic field . 808

Reviews of Books 809

Part 6 *December* 1960

Dr. R. Cooper, Mr. R. M. Higgin and Dr. W. A. Smith. The influence of ionic conductivity on the electric strength of KCl and NaCl 817

Dr. W. E. Spear. The hole mobility in selenium 826

Dr. Anne Pery-Thorne and Dr. W. R. S. Garton. Absorption of Krypton in the extreme ultra-violet 833

Mr. D. S. Pešić. Isotope effect in band spectra of magnesium oxide . . 844

Mr. H. J. Pain and Mr. P. R. Smy. Magnetic field interactions with shock ionized argon 849

Mr. J. L. Robins and Dr. J. B. Swan. Characteristic electron energy loss spectra of the transition metals, Ti to Cu 857

Dr. E. H. Linfoot. Wave-theoretic and ray-theoretic contrast transmission functions 870

PAGE

Mr. W. B. Bonnor. The field of an electric current in general relativity . . 891

Dr. D. L. Greenaway. Infra-red investigation of the acceptor levels formed by copper in germanium 900

Dr. R. Englman. The discontinuities in the solutions of the transport equation and the variational principle 909

Dr. A. A. Jaffe, Dr. F. de S. Barros, Dr. P. D. Forsyth, Dr. J. Muto, Dr. I. J. Taylor and Mrs. S. Ramavataram. Some (t, p) reactions in light nuclei . 914

Dr. J. C. Lisle and Dr. P. F. D. Shaw. Gamma radiation following resonant proton capture by chlorine 929

Mr. S. J. Fray, Dr. F. A. Johnson and Dr. R. H. Jones. Lattice absorption bands in indium antimonide 939

Miss Daphne F. Jackson. Form factors of the nucleus ^{6}Li. 949

Dr. R. B. Banerji. Anisotropy in ionospheric diffraction and its effect on drift measurement 959

Mr. W. S. Carter. The specific heats of two polymorphic forms of manganous sulphide, and the inferred possibility of antiferromagnetic ordering in stacking faults 969

Mr. J. S. M. Harvey, Dr. R. A. Kamper and Dr. K. R. Lea. Paramagnetic resonance absorption in bromine and chlorine 979

Research Notes:

Dr. G. L. Sewell. Electric conduction in antiferromagnetics . . . 985

Dr. B. H. Bransden and Mr. R. A. H. Hamilton. The elastic scattering of ^{3}He by ^{3}He 987

Dr. W. G. Henry. The Knight shift in alloys 989

Dr. R. C. Newman. The identification of precipitate particles in single crystals of silicon by reflection electron diffraction 993

Mr. G. D. Jones and Dr. W. A. Runciman. The infra-red absorption spectra of potassium manganicyanide and vanadium corundum 996

Dr. D. R. Sweetman. The lifetime of the He^{-} Ion 998

Letters to the Editor:

Dr. B. V. Rollin and Mr. J. M. Rowell. Hot carriers in germanium . 1001

Corrigendum: Mr. D. W. L. Sprung and Dr. J. B. Willis 1002

Reviews of Books 1003

Subject Index, Vol. 76 1009

Index to Authors (with Titles), Vol. 76 1015

Index to Reviews of Books, Vol. 76 1022